

presumed to be sparser offshore than inshore for marine birds (p. 247, although terns are apparently an exception—p. 263), and above the forest canopy than within it for swifts (p. 195), but little attention is paid to the fact that for each of the areas in which food is supposedly less abundant birds also have to travel much farther for it.

The coevolution of such factors as food availability, number and growth rate of the young, predation, and others that affect the survival rates of parents and young in my view receives inadequate treatment, yet is the essence of the problem. Perhaps only a really cohesive and simultaneous handling of variables, preceded by some a priori structuring and grouping on which individual subrelations can be hung, will avoid the rather confusing mass of cross-relations through which *Ecological Adaptations* takes us. The book pushes its approach as far as it can go, but in fact little further insight into its difficult subject has been gained since Cole's 1954 paper (3). Perhaps the problems will prove more amenable in the hands of the "strategists," by whom several tentative starts have been made (4).

A concluding word should mention the delightful drawings by Robert Gillmor, which do much to make progress through the book more enjoyable.

MARTIN CODY

Department of Zoology,
University of California, Los Angeles

References

1. R. K. Selander, *Amer. Naturalist* **99**, 129 (1965).
2. K. Crowell, *Proc. Natl. Acad. Sci. U.S.* **67**, 240-43 (1961).
3. L. C. Cole, *Quart. Rev. Biol.* **29**, No. 2, 103-37 (1954).
4. See, for example, G. L. Murphy, *Amer. Naturalist* **102**, 391 (1968).

Physiological Optics

Light, Colour and Vision. YVES LE GRAND. Second English edition, translated from the French by R. W. G. Hunt, J. W. T. Walsh, and F. R. W. Hunt. Chapman and Hall, London, 1968 (U.S. distributor, Barnes and Noble, New York). xiv + 566 pp., illus. \$11.25.

Optique Physiologique was originally published as three volumes in 1946, 1948, and 1956. Volume 1, *La Dioptrique de l'Œil et Sa Correction*, has twice been revised, but has not yet been translated into English (it should be). Volume 3 has recently been translated as *Form and Space Vision* by Millodot and Heath (Indiana Uni-

versity Press, 1968). The first English edition of the second volume, considerably updated, appeared as *Light, Colour and Vision* in 1957. Superbly translated by a distinguished trio of British specialists, it achieved rapid acclaim and has become one of the most widely cited modern sources of fundamental information about vision. The appearance of this second English edition will be greeted with particular interest by those who have made extensive use of the first.

Robert Cunningham and Sons have once again done the printing: binding, paper, type, plates, and format are so similar that the new edition might easily be mistaken for the old. And a careful examination reveals many more similarities. The same 20 chapters are again distributed within two major groupings. Section A, containing the first 15, includes "Experimental Facts," while "Theories of Vision" are presented in section B. All of an original 210 subheadings are retained in section A, where only five new ones ("absorption in the lens," "standard daylights," "the colorimetry of large fields," "colour contrast," "the problem of flash blindness") are listed.

But there are also many changes. An examination of the bibliography reveals that an extensive amount of new literature has been cited. The first edition contained a numbered list of 190 specially selected books and fully referenced journal articles of "wide scope." To this list 81 new items have been added. The original 13½ pages of additional journal references, cited without titles, have been expanded to 21 pages.

Although the updating of section A is a patchwork affair, it reveals that physicist Le Grand has been keeping a sophisticated eye on recent developments. Most readers are likely to find many references that they have overlooked during the productive decade that elapsed between editions.

With the help of two of the original translators, section B has been extensively revised. More than 20 new subsections have been written, and six of the old ones have been deleted. These changes reflect contributions to visual theory resulting from new advances in electrophysiology, psychophysics, retinal densitometry, microspectrophotometry, and photochemistry. To the physiologist, these sections will again seem superficial; Le Grand admits that this material is "less familiar to me" than what is covered in section A.

Few changes have been made in the extensive tables and formulas which comprise valuable features of the book. All original figures except one have been retained: only five new ones have been added. Regrettably, ten pages of exercises and their solutions (this was originally a textbook) have been eliminated, probably to keep the volume—now ten percent thicker—within bounds. The index is again excellent.

Le Grand's opinions are sprinkled throughout the book, particularly in section B. The reader will probably wish to quarrel with some of them. But they make for lively reading and are not too rigidly held. As Le Grand puts it: "even if this Section B contains a little science-fiction, it is of great importance for men of science to try to understand the human machine." Those who study this book will be rewarded by an enhanced understanding of the physics of human vision.

ROBERT M. BOYNTON

Center for Visual Science, University
of Rochester, Rochester, New York

Gamete Fusion

Ultrastructure of Fertilization. C. R. AUSTIN. Holt, Rinehart and Winston, New York, 1968. x + 198 pp., illus. \$5.95.

Electron microscopy has been brought to bear on fertilization only in the past decade. Not all stages known histologically have yet been seen at the higher magnifications. The author of *Ultrastructure of Fertilization* briefly mentions what has not been studied and why, then summarizes what has been. The acrosome reaction, the cortical granule response, and relations between gamete cell membranes have been studied in most detail, in sequential stages, and in various species. Sperm penetration through egg investments is sufficiently understood to permit a very systematic presentation with subsections on sperm structure, egg investments, and sperm penetration for each of nine invertebrate groups and mammals (chiefly rabbit). Conjugating protozoa as well as gametes have been considered with respect to nuclear migration, nuclear union, and especially those cell membrane interactions that lead to cell fusion. In such matters of how cell membranes merge and where and what they come from and disappear to, research is moving beyond high-magnification comparative anatomy through